ENGINEERS POCKETBOOK

BAC ONE-ELEVEN

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3-5-0 Wings

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ENGINEERS POCKETBOOK

BAC ONE-ELEVEN

STRUCTURES-GENERAL

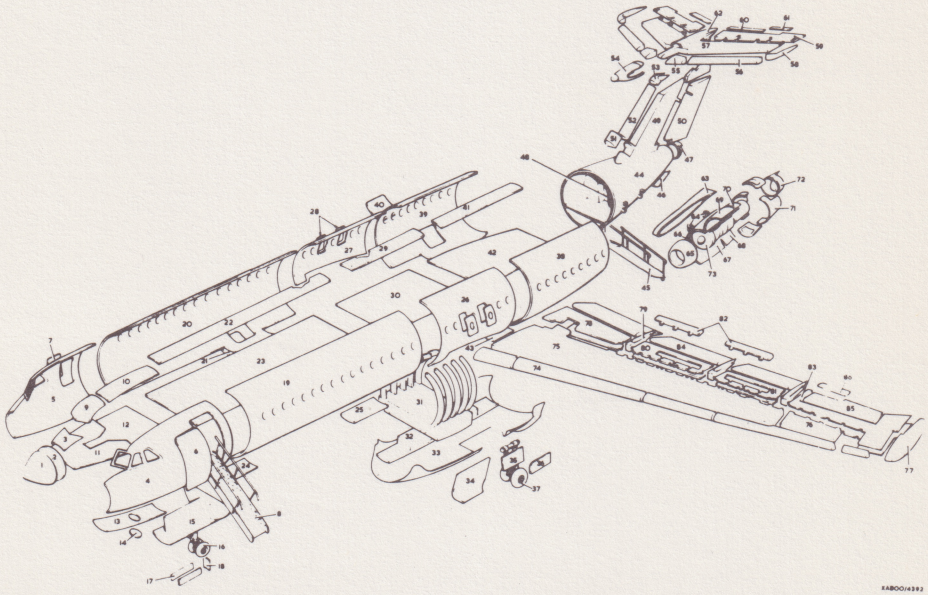
The primary structure is designed on a conservative 'fail safe' concept. Alternative paths for the structure loads are provided so that the failure, or partial failure, of a single main structure member does not in itself cause the collapse of the structure as a whole, or reduce the strength of the structure below that required to sustain design flight loads.

The basic materials used in the structure of the aircraft are light alloy and steel.

Skins and plating are generally flush-riveted.

To prevent corrosion, all external surfaces are painted except the leading edges of the wing, fin and tailplane, engine nacelles, stub fairings and the underside of the fuselage, aft of the undercarriage bay.

Where honeycomb construction is used, the design is such as to minimise the possibility of the accumulation of moisture.

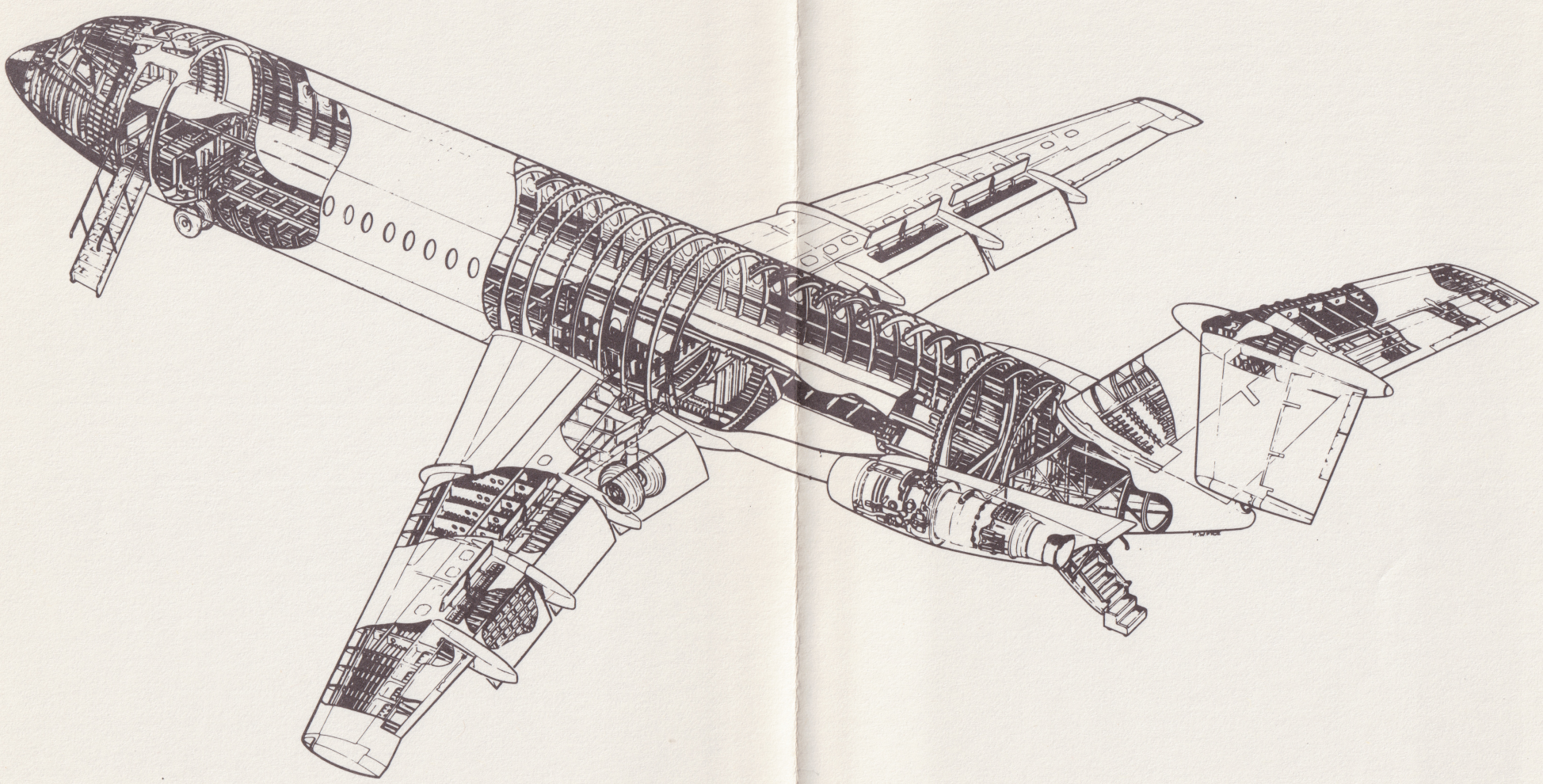


Structure Breakdown
Figure

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XAB00/43938

G.A. of Structure
Figure 2

FUSELAGE

General

The fuselage comprises three main sections; the front section extends to Stn.556 and has a manufacturing joint at Stn.230; the centre section extends to Stn.928 with a joint at Stn.730; the rear section is integral with the vertical stabilizer.

The centre fuselage side panels with window apertures, above the wing attachment area, have internally machined stringers.

CENTRE-SECTION TORQUE BOX

The centre section torque box is sealed internally and used as a fuel tank; it forms the attachment for the wings, is attached to the fuselage by five heavy-duty machined light alloy frames.

KEEL

The keel which passes under the torque box is a rigid box-section member, it connects the bulkheads at Stns. 556 and 730 and is stabilized by two transverse box section beams connecting it to the centre section.

The main cabin floor is supported by longitudinal and transverse light alloy beams which in turn are supported by vertical struts. The longitudinal beams support the seat rails. The removable panels are of sandwich construction.

PRESSURE BULKHEADS

Pressure bulkheads are situated at Stns.53 and 996 and below floor level at Stns.556 and 730 (torque box area). A passenger doorway is situated in the bulkhead at Stn.996 and the ventral door winding gear is mounted on the rear face.

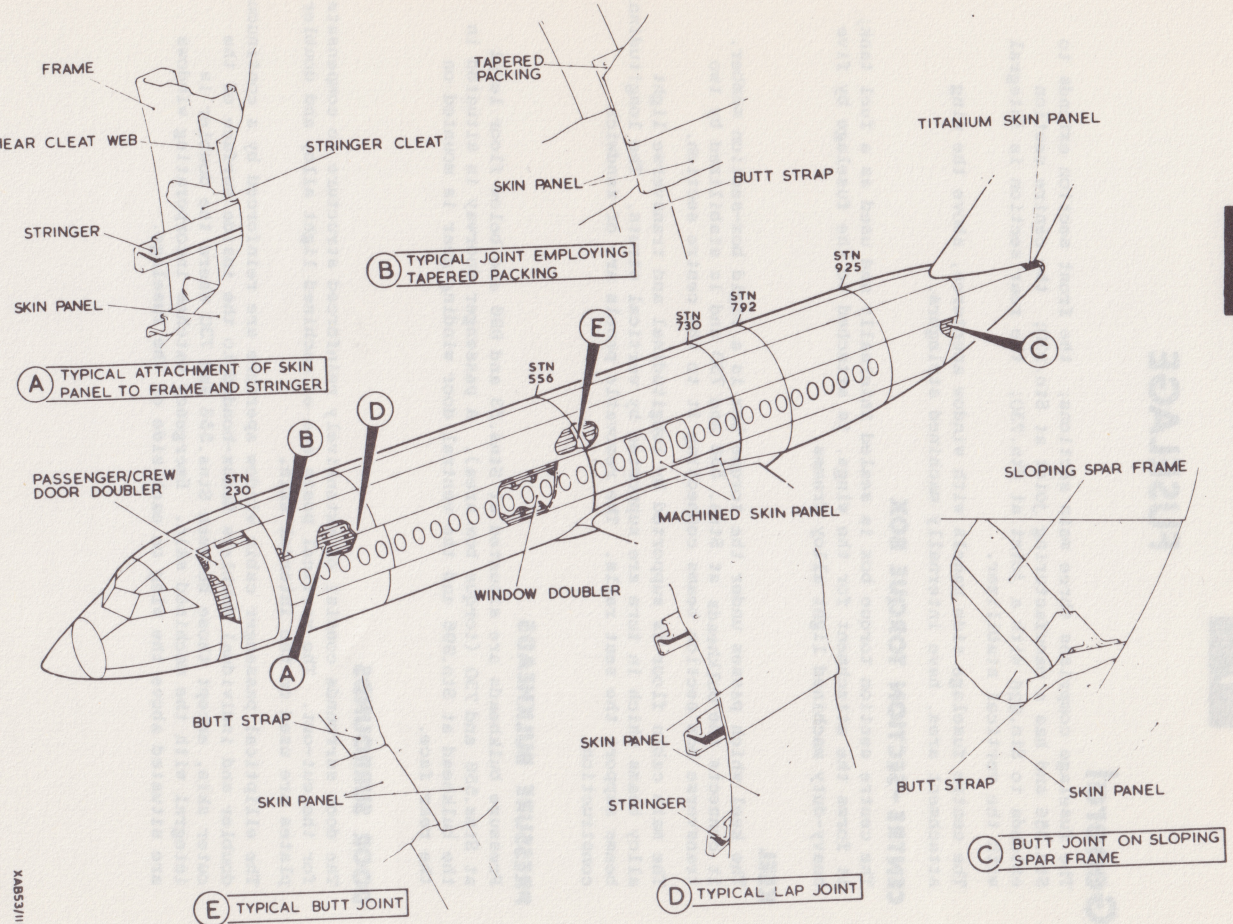
DOOR SURROUNDS

The door surrounds consist of extensively reinforced structure to compensate for the cut-out. The vertical posts are of machined light alloy and doubler plates are used on the internal skin.

The elliptical passenger cabin window aperture are reinforced by a continuous doubler and individual doublers Redux-bonded to the inside surface of the outer skin, except those between Stns.556 and 730 where the doubler is integral with the machined skin. Emergency hatches incorporating windows are situated above the wing on each side of the fuselage.

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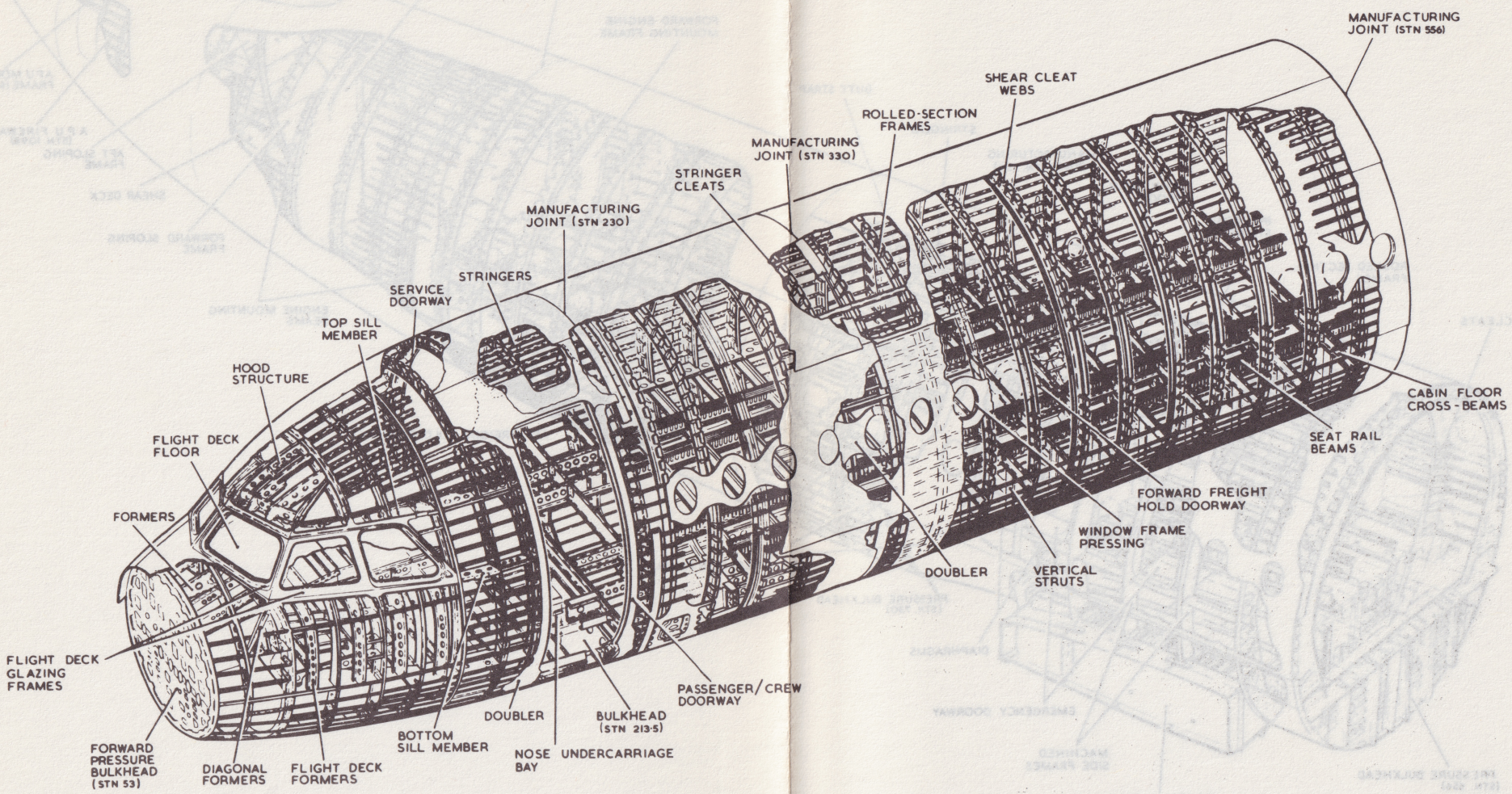


Skinning Details
Figure 1

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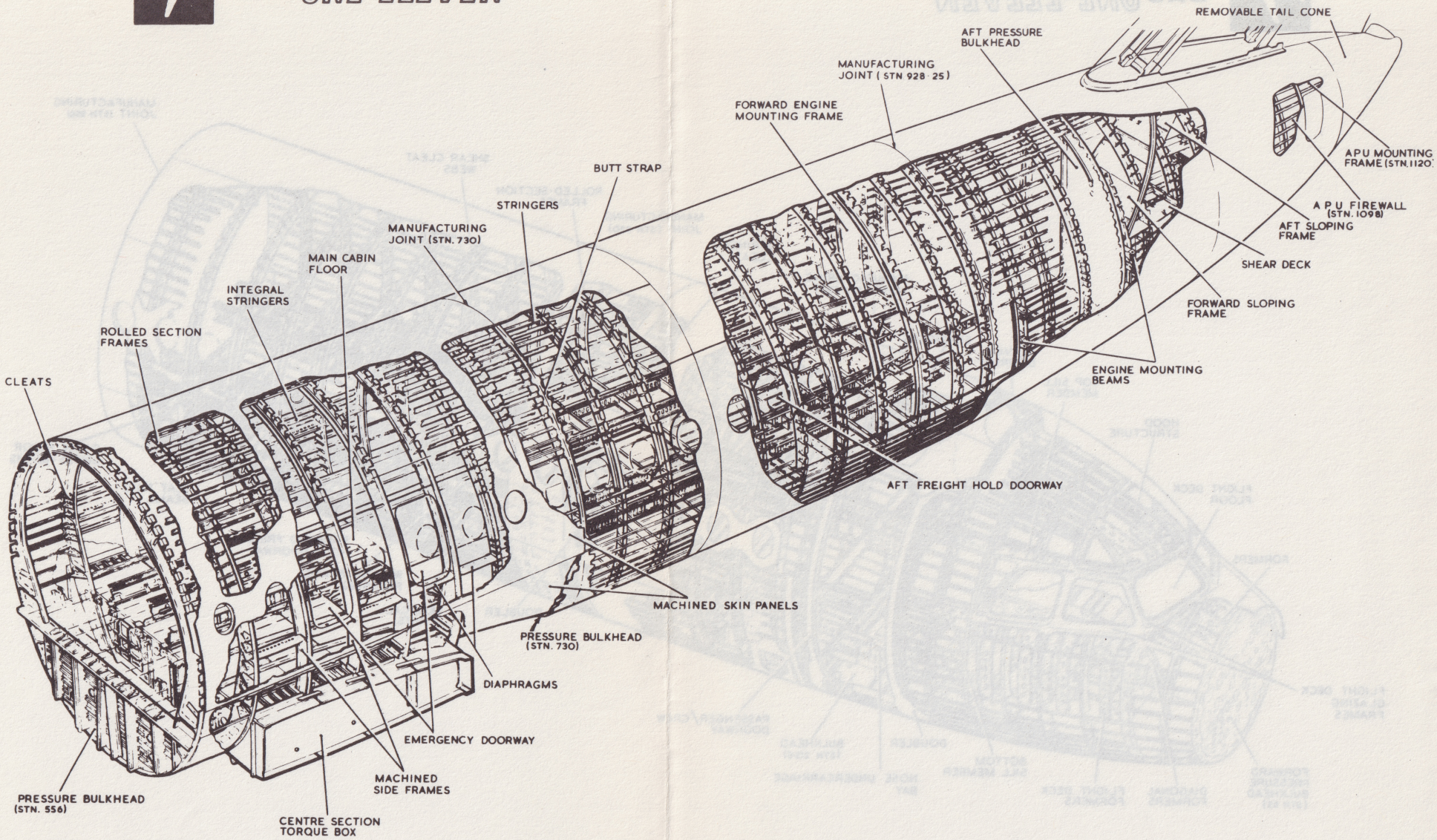
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XAB 53/1131

Front Fuselage
Figure 2

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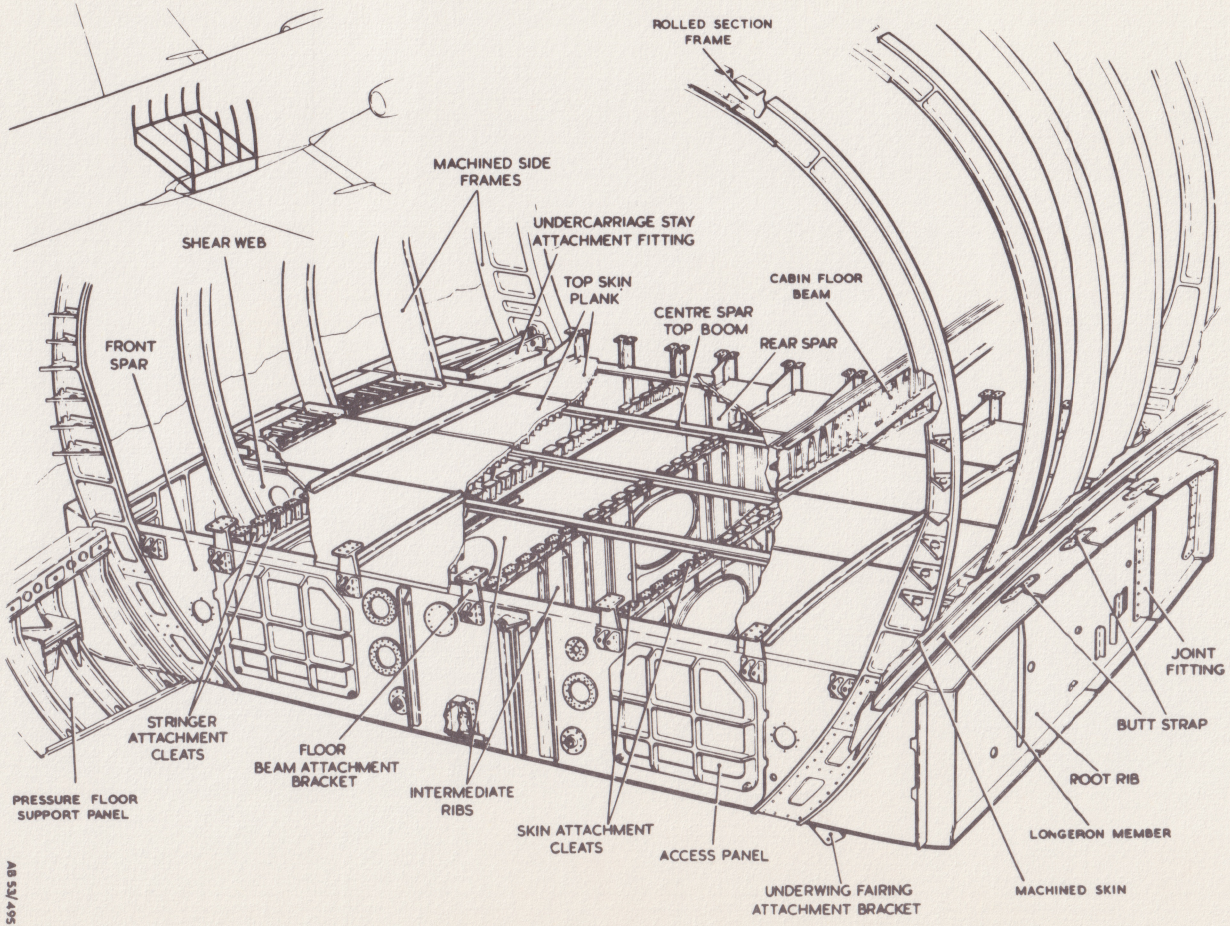


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Centre and Rear Fuselage
Figure 3

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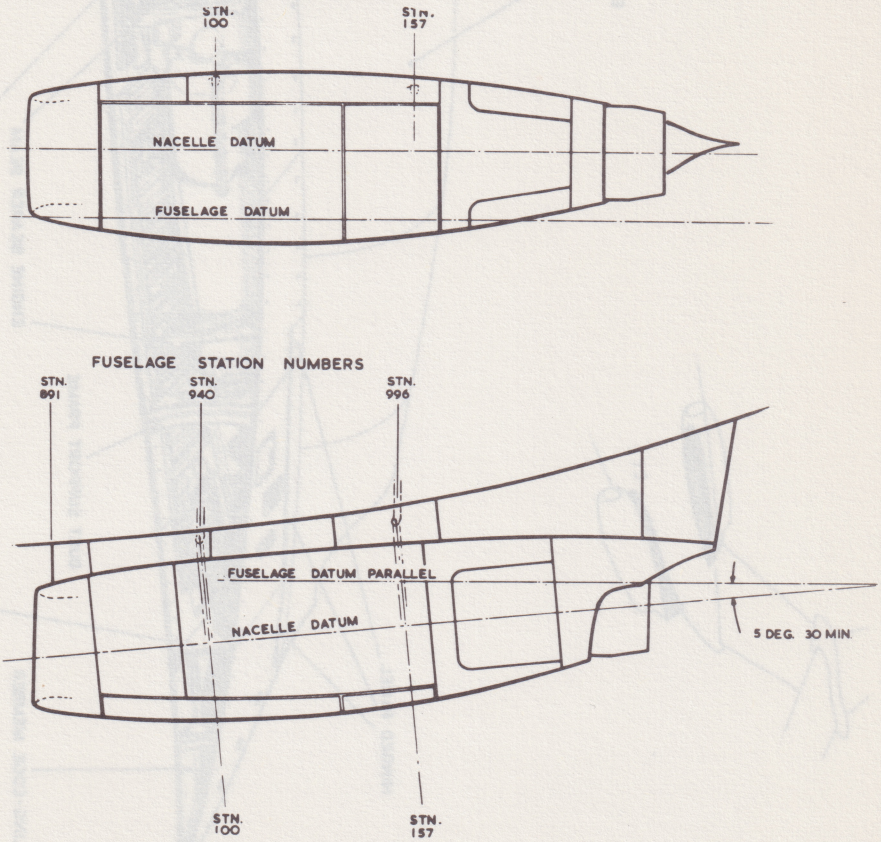
Centre Torque Box
Figure 4

AB 53/495

NACELLES

The engine nacelles are mounted one on each side of the rear fuselage. They are structurally similar and are carried by two forged beams. A thrust strut attached to the front inboard engine mounting is connected to a reaction beam on the fuselage.

The stub fairing encloses the engine bearer beams, ducting and engine services. The leading-edge section is bolted to the forward bulkhead and the trailing-edge section is attached to the fuselage and support brackets in the stub fairing. Between the leading and the trailing edges, the upper and lower detachable panels are supported by bulkheads, support frames, the fixed cowl and a fuselage drag angle.



Nacelle Stations
Figure 1

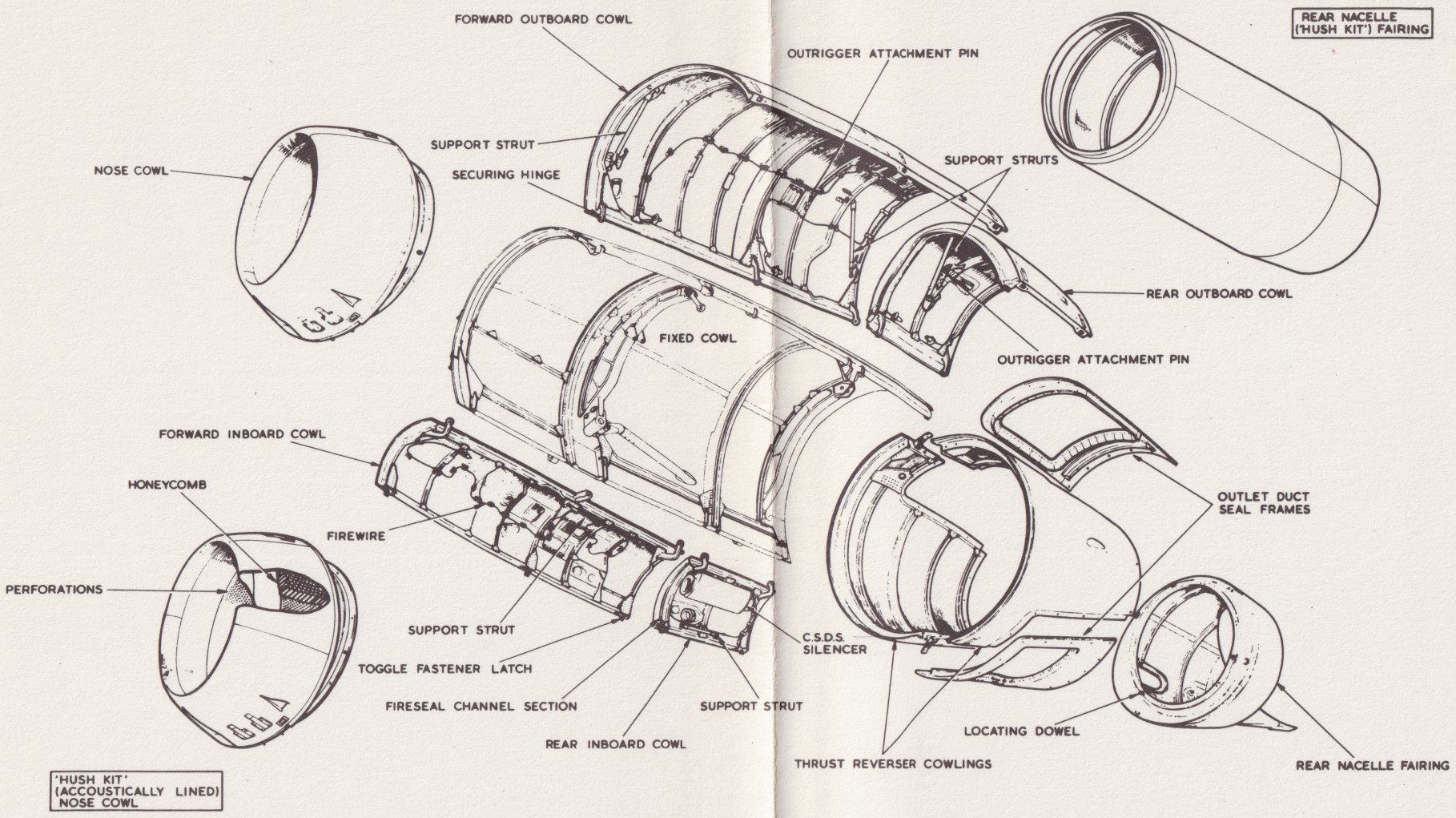
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G.A. of Stub Fairing
Figure 2

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Cowling Details
Figure 3

STABILIZERS

General

The stabilizers include a variable-incidence horizontal stabilizer (tail-plane) and a fixed vertical stabilizer (fin) together with their associated movable services, i.e. elevators and rudder.

TAILPLANE

The tailplane is a two spar torsion-box structure with forward and aft outer and inner spars, interspar ribs and stringer-supported, flush-riveted top, and machined bottom,skin panels. A bullet-shaped fairing is attached to the centre of the tailplane and encloses the elevator control scissor mechanism. The leading edges, trailing edges and tip are detachable, being secured with countersunk bolts. The detachable tips are made of moulded glass cloth and the aft section of the top skin panel is bonded honeycomb.

ELEVATOR

Each elevator has main, centre and tab shroud spars, interspar ribs at the hinge stations and skin panels of bonded honeycomb.

FIN

The vertical stabilizer (fin) consists of two spars, eight interspar ribs and stringer-supported skin panels, forming a torque box to which are attached a removable leading edge, a rudder stub and the forward part of the bullet fairing. Mounting plates at the junction of the top of the forward spar and the top rib, support the tailplane variable incidence actuator. The tailplane pivot structure is assembled at the junction of the aft spar and the top rib. Top and bottom hinge structures extend from the aft spar to support the rudder. Access panels are situated in the leading edge, fin structure, fin bullet, skin panels and shroud closing plates.

RUDDER

The rudder has main, centre and aft spars, leading edge spars between and above the hinge assemblies and intermediate ribs. The structure is enclosed by bonded honeycomb skin panels; riveted and bolted to the spars and ribs. Top and bottom bearing assemblies, with jack fittings in the bottom assembly, are bolted to the forward face of the main spar; detachable panels giving access to the top hinge assembly are fitted in the left hand nose panels. Slinging points are provided in the nose ribs, attached to the main spar. Detachable shrouds, secured with countersunk bolts, are fitted to the lower booms of the cut-off nose rib, and to right and left booms attached with riveted brackets to the main spar, above the bottom hinge assembly.

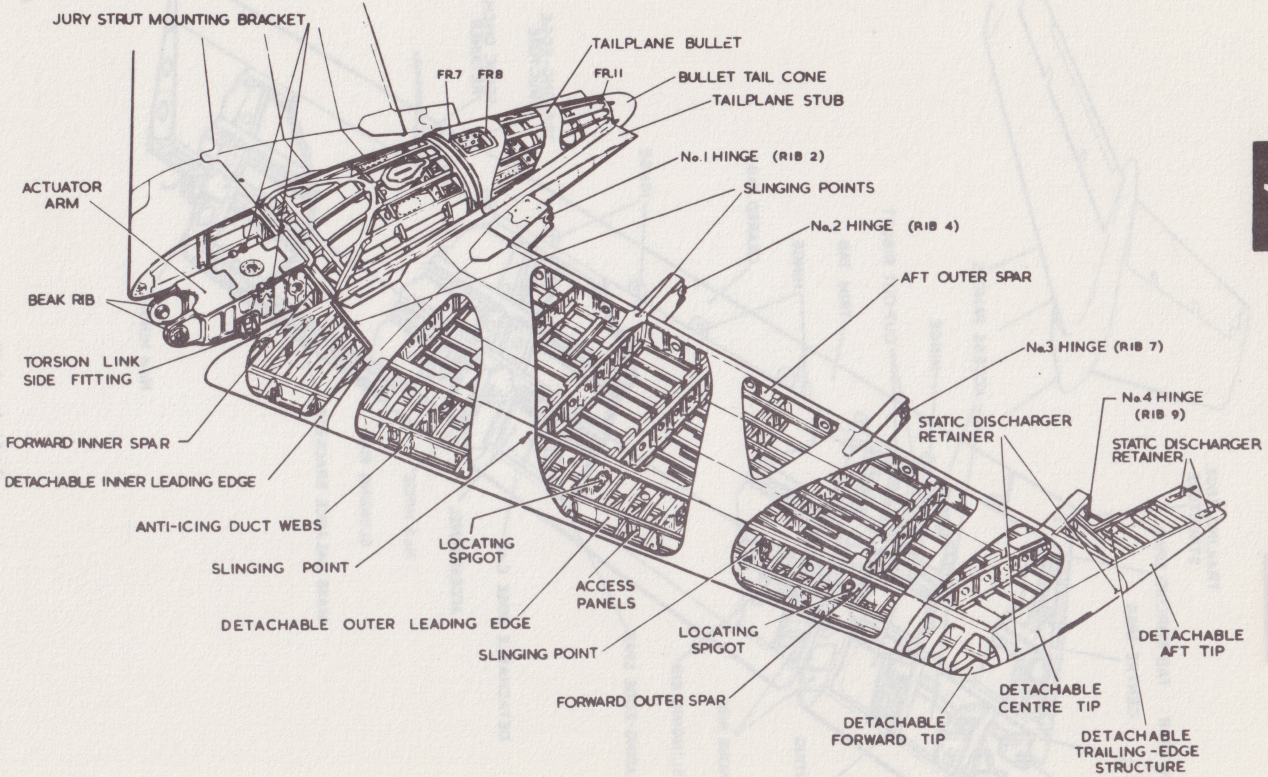
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G.A. of Stabilizers
Figure 1

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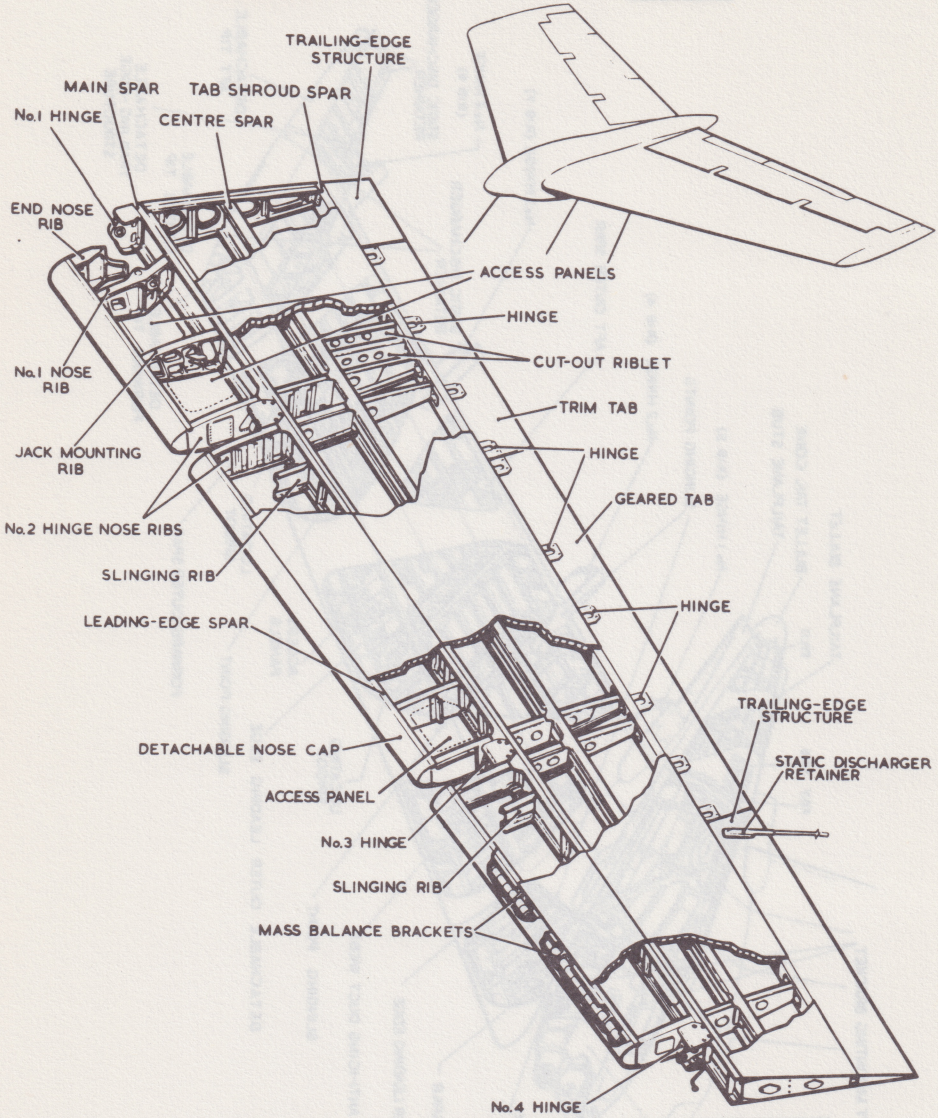
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Tailplane
Figure 2

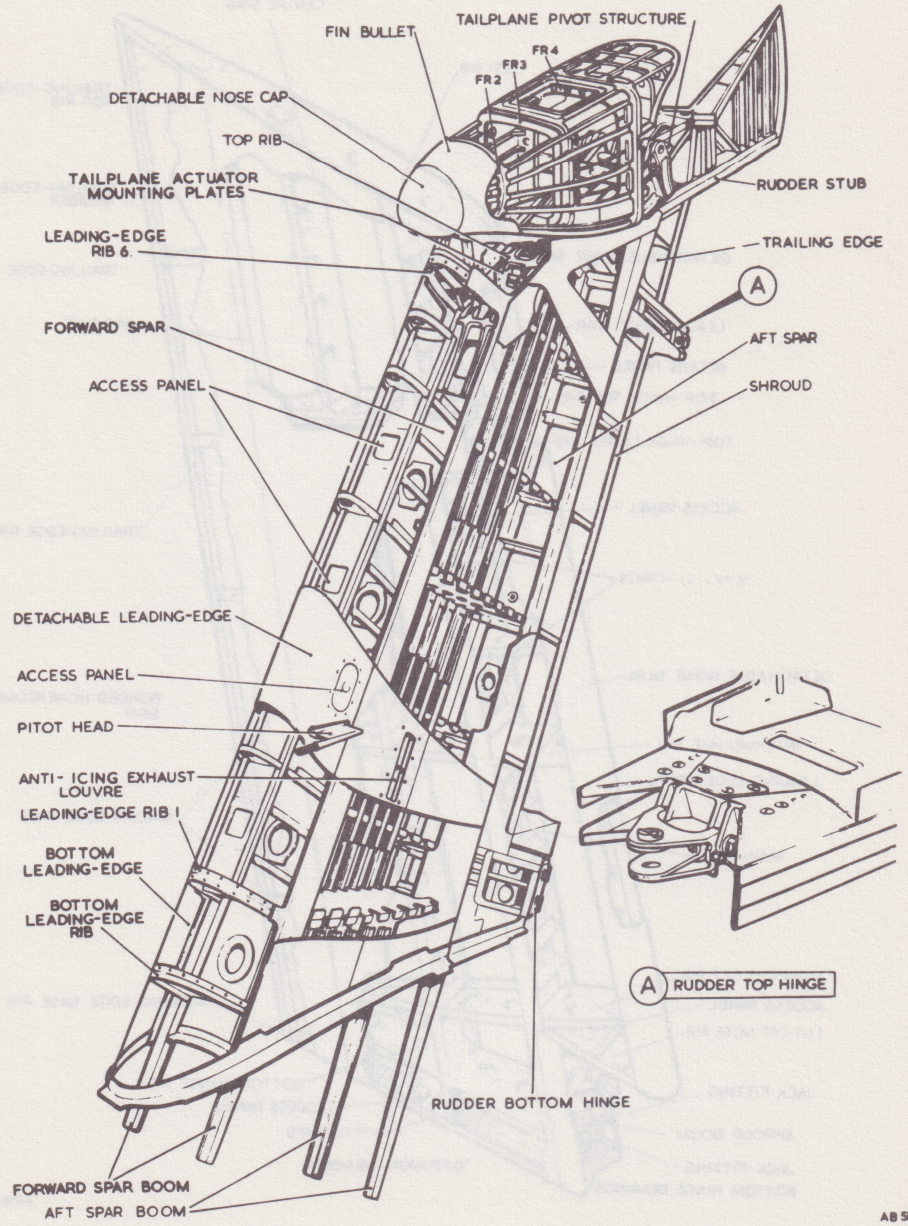
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AB 55/78

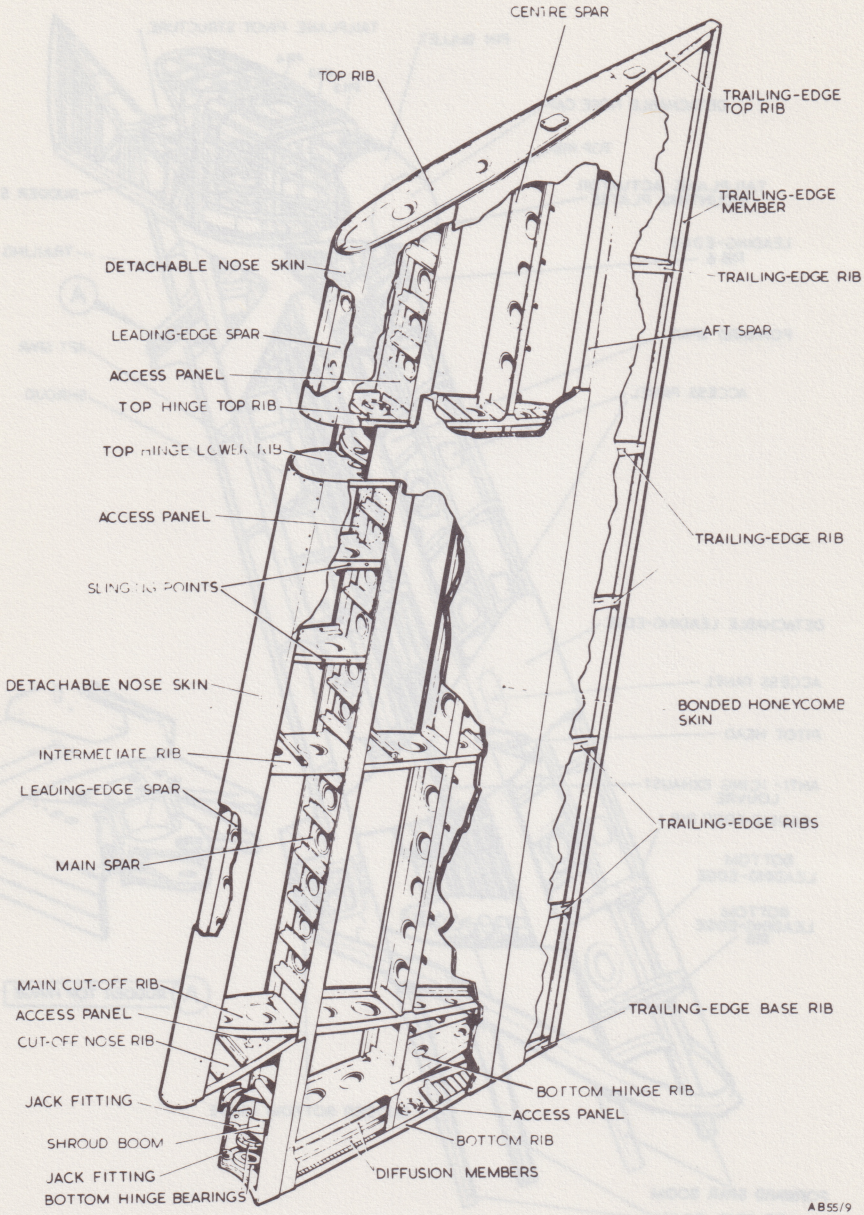
Left-hand Elevator
Figure 3

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Fin
Figure 4

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Rudder
Figure 5

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WINDOWS

Flight Deck

The windscreens are of five-ply glass/polyvinyl butyl construction, the innermost (glass) laminate being low-tempered to form a splinter shield in the event of bird-strike.

The opening direct vision (D.V.) and fixed side windows may, as effected by the aircraft modification state or by spares replacement, be either of similar construction to the windscreens, or of the 'acrylic' type. In the latter, acrylic laminates supersede the glass laminates.

Although physically interchangeable, panels of both types should not be installed concurrently on one side of the flight deck because the respective heating levels are different.

All flight deck windows have built-in heating elements, the direct vision (D.V.) windows being micro-switched off when open.

D.V. Windows can be opened only from inside.

Fur further details in window heating, see Section 2-11-0, 'Ice and Rain'.

DEFECTS AND LIMITATIONS — ALL FLIGHT DECK WINDOWS (GLASS/POLYVINYL BUTYL TYPE)

DEFECTS STATED BELOW TO BE PERMISSIBLE, ARE WITHIN THE MINIMUM STRUCTURAL SAFETY STANDARDS. IN ALL CASES HOWEVER, THE PILOT MUST CONFIRM SATISFACTION THAT VISIBILITY IS NOT DANGEROUSLY IMPARED.

CRACKS AND CRAZING

Hair-line cracks in the innermost glass of any window are not critical.

Failure of the middle glass appears as heavy granular crazing.

Failure of the outer glass appears as light crazing and, on the windscreen, may cause heating failure in the affected panel.

Crazing of a middle or outer glass necessitates renewal.

SCORES

On the WINDSCREENS, a score deeper than 0.003 in., on the outer surface necessitates renewal, as will any score of very sharp form irrespective of depth.

D.V. and side windows with external scores should be renewed, but this may be deferred until failure of the outer glass.

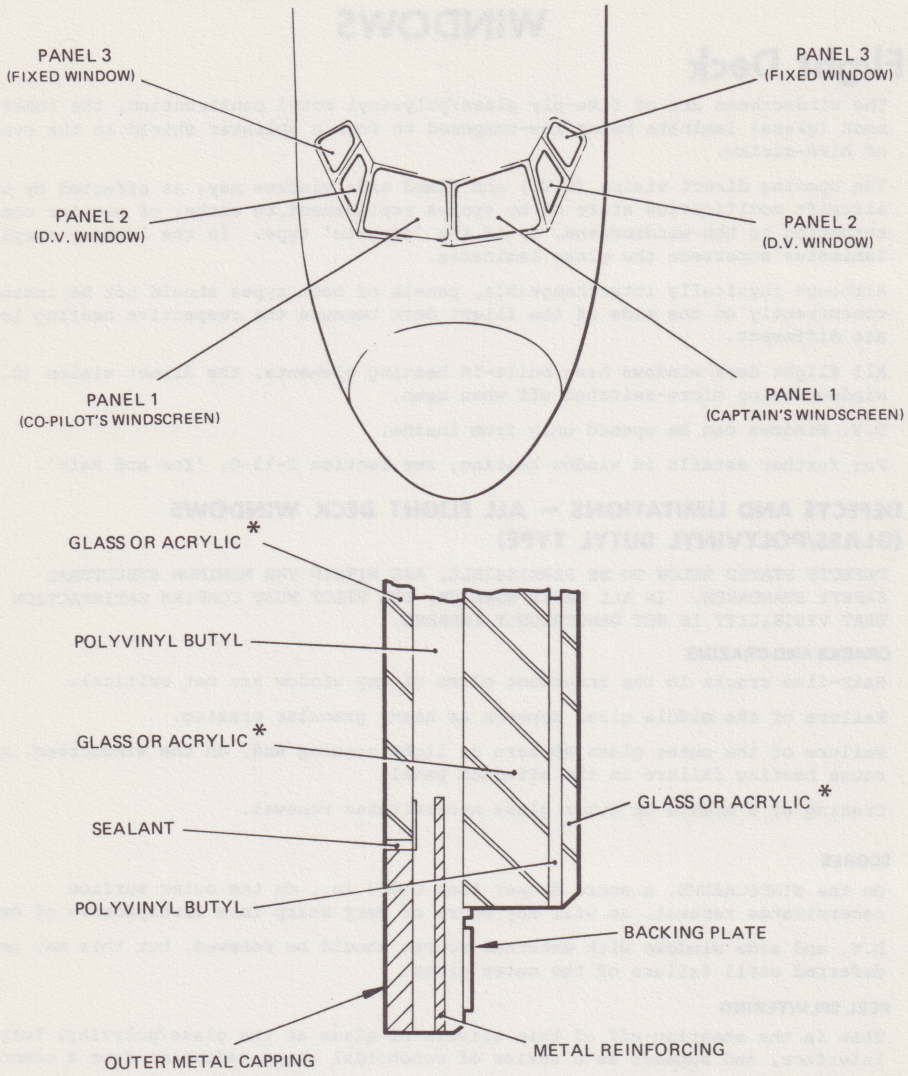
PEEL SPLINTERING

This is the shearing-off of thin slivers of glass at the glass/polyvinyl butyl interface, and appears as a series of conchoidal chips radiating from a common centre.

Windscreens with this defect must be renewed.

D.V. and side windows need be immediately renewed unless visibility is impaired. 'Peel Splintering' should be carefully monitored and, provided the affected area does not suddenly enlarge, renewal may be deferred until visibility becomes unsatisfactory.

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WINDOW LAMINATIONS

* NOTE: ALTERNATIVE IN D.V. AND SIDE WINDOWS ONLY

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Flight Deck Windows

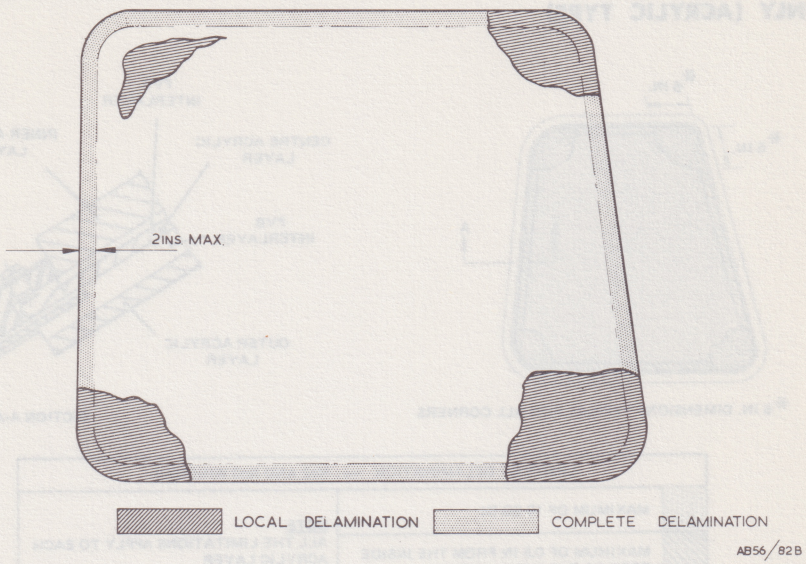
Figure 1

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Flight Deck Windows
Glass/Polyvinyl Butyl Type - Delamination Limits
Figure 2

DELAMINATION

This defect is visible in the form of 'bubbles' between the laminates and the following limits of acceptable delamination apply to all fixed and sliding windows:-

Complete delamination of the area between the periphery of the glass panel and an imaginary boundary 2.0 in. inside and parallel to the periphery.

Local delamination (see Fig.2) of areas not exceeding a total of 40 sq.in. Areas of delamination restricted only by an acceptable standard of visibility.

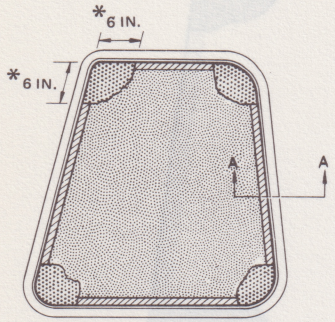
DOUBLE DELAMINATION

This describes an area extending from the panel periphery where separation of the glass panels occurs both on the inside and the outside of a polyvinyl butyl interlayer. Panels with this defect must be renewed at the earliest opportunity and not later than the next schedule servicing period.

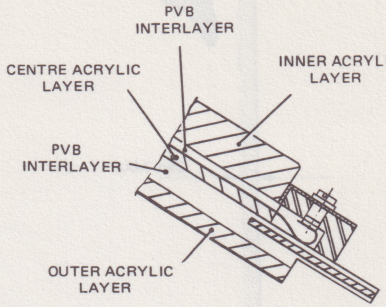
WINDOW SEAL LEAKS

These may be eliminated, provided that the seal is serviceable, by evenly re-tightening the attachment bolts to a maximum torque of 5 lb. in.

DEFECTS AND LIMITATIONS — FLIGHT DECK D.V. AND FIXED SIDE WINDOWS ONLY (ACRYLIC TYPE)



*6 IN. DIMENSIONS TYPICAL FOR ALL CORNERS



SECTION A-A

LIMITS OF DELAMINATION — No2 AND No3 WINDOWS		
	MAXIMUM OF 10 SQ IN	NOTE ALL THE LIMITATIONS APPLY TO EACH ACRYLIC LAYER
	MAXIMUM OF 0.5 IN FROM THE INSIDE EDGE OF THE METAL INSERT	
	INDIVIDUAL AREAS MUST NOT EXCEED 2 SQ IN. TOTAL AGGREGATE OF AREAS MUST NOT EXCEED 6 SQ IN. NOTE THIS LIMITATION IS ALSO SUBJECT TO AN ACCEPTABLE STANDARD OF VISIBILITY THROUGH THE PANEL	CAUTION THERE MUST BE NO SUPERIMPOSED DOUBLE DELAMINATION OF OUTER AND CENTRE ACRYLIC LAYERS

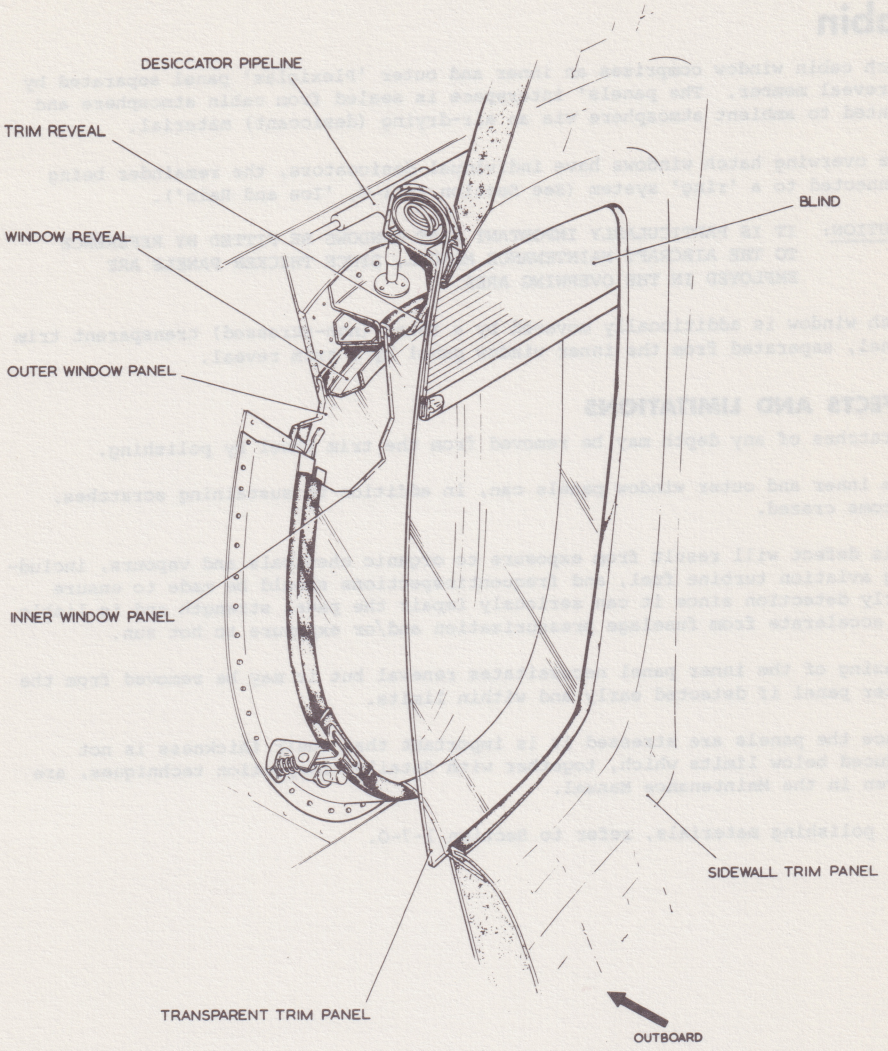
AB56/27C

Flight Deck D.V. and Fixed Side Windows
Acrylic Type - Delamination Limits
Figure 3

	MATERIAL	DISTORTION	CRAZING	SCORES	SCRATCHES	SINGLE DELAMINATION
NO.2 AND NO.3 WINDOWS	ACRYLIC LAYERS WITH PVB INTER-LAYERS	ALLOWABLE SUBJECT TO AN ACCEPTABLE STANDARD OF VISIBILITY THROUGH THE PANEL	ALLOWABLE SUBJECT TO:- 1. AN ACCEPTABLE STANDARD OF VISIBILITY THROUGH THE PANEL. 2. THE INTEGRITY OF THE PANEL IS NOT SUSPECT. MAXIMUM DEPTH 0.010 in. POLISH OUT AS DETAILED IN THE MAINTENANCE MANUAL.			ALLOWABLE WITHIN THE LIMITATIONS DETAILED IN FIGURE 3.

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Cabin Window
Figure 3

Cabin

Each cabin window comprises an inner and outer 'Plexiglas' panel separated by a reveal member. The panels' interspace is sealed from cabin atmosphere and vented to ambient atmosphere via an air-drying (desiccant) material.

The overwing hatch windows have individual desiccators, the remainder being connected to a 'ring' system (See Section 2-11-0, 'Ice and Rain').

CAUTION: IT IS PARTICULARLY IMPORTANT THAT WINDOWS BE FITTED BY REFERENCE TO THE AIRCRAFT MAINTENANCE MANUAL, SINCE THICKER PANELS ARE EMPLOYED IN THE OVERWING AREA.

Each window is additionally covered by a third (non-stressed) transparent trim panel, separated from the inner window panel by a trim reveal.

DEFECTS AND LIMITATIONS

Scratches of any depth may be removed from the trim panel by polishing.

The inner and outer window panels can, in addition to sustaining scratches, become crazed.

This defect will result from exposure to organic chemicals and vapours, including aviation turbine fuel, and frequentinspections should be made to ensure early detection since it can seriously impair the panel strength and is liable to accelerate from fuselage pressurization and/or exposure to hot sun.

Crazing of the inner panel necessitates renewal but it may be removed from the outer panel if detected early and within limits.

Since the panels are stressed it is important that their thickness is not reduced below limits which, together with detailed inspection techniques, are given in the Maintenance Manual.

For polishing materials, refer to Section 1-7-0.

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WINGS

Each wing consists basically of a centre torsion box with leading and trailing edge structures attached. The wings are joined by multiple butt straps to the centre torque box built into the fuselage. The structure comprises front, centre and rear spars and interspar ribs and is covered over the greater part of its length (upper and lower surfaces) by skin panels with integrally machined stringers. A small area at the tip is covered with lighter gauge skin stiffened with orthodox stringers.

The structure between the wing root and rib 17 forms an integral fuel tank and two further bays, between rib 17 and 19 form a vent/surge tank. Sealed ribs divide the main tank into separate compartments and the remaining ribs serve as fuel baffles.

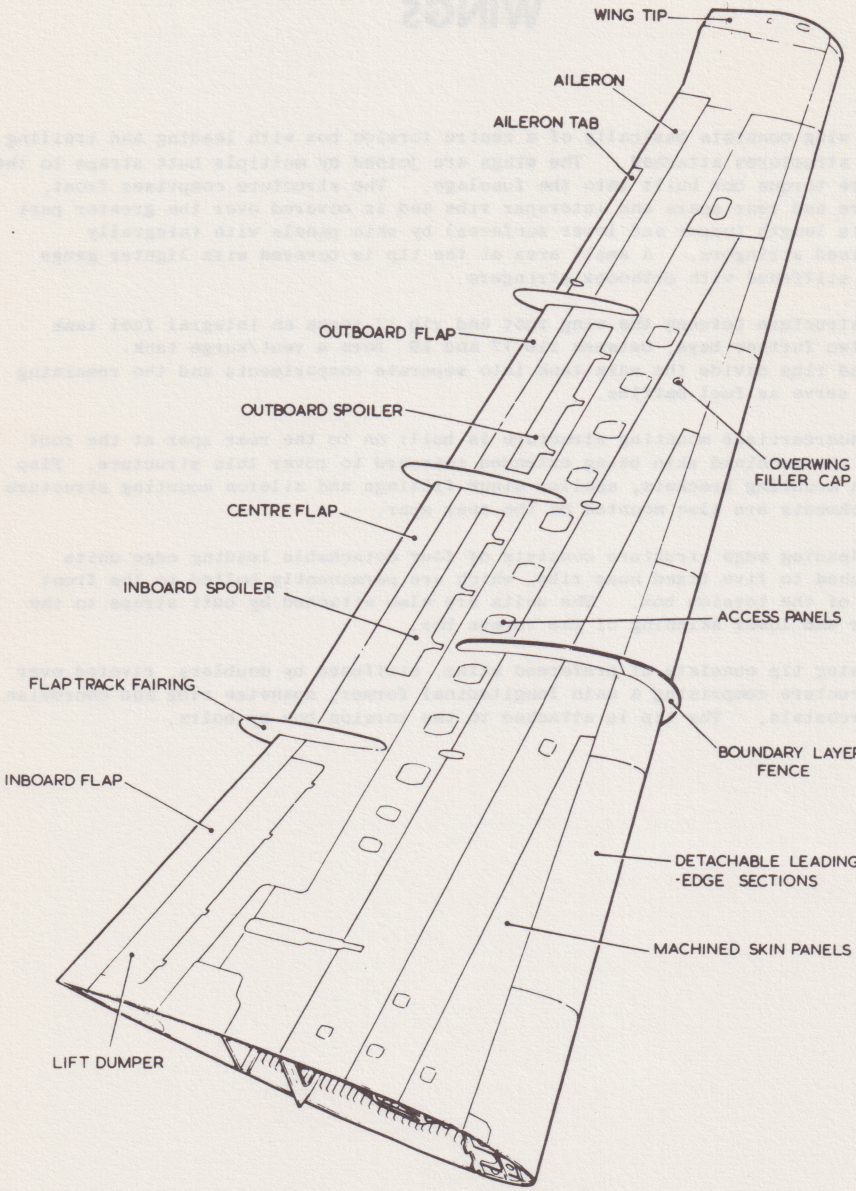
An undercarriage mounting structure is built on to the rear spar at the root end, the machined skin being extended rearward to cover this structure. Flap track mounting brackets, spoiler hinge fittings and aileron mounting structure attachments are also mounted on the rear spar.

The leading edge structure consists of four detachable leading edge units attached to five fixed nose ribs, which are permanently bolted to the front spar of the torsion box. The units are also attached by butt straps to the upper and lower skinning of the torque box.

The wing tip consists of preformed skins, stiffened by doublers, riveted over a structure comprising a main longitudinal former, spanwise ribs and chordwise intercostals. The tip is attached to the torsion box by bolts.

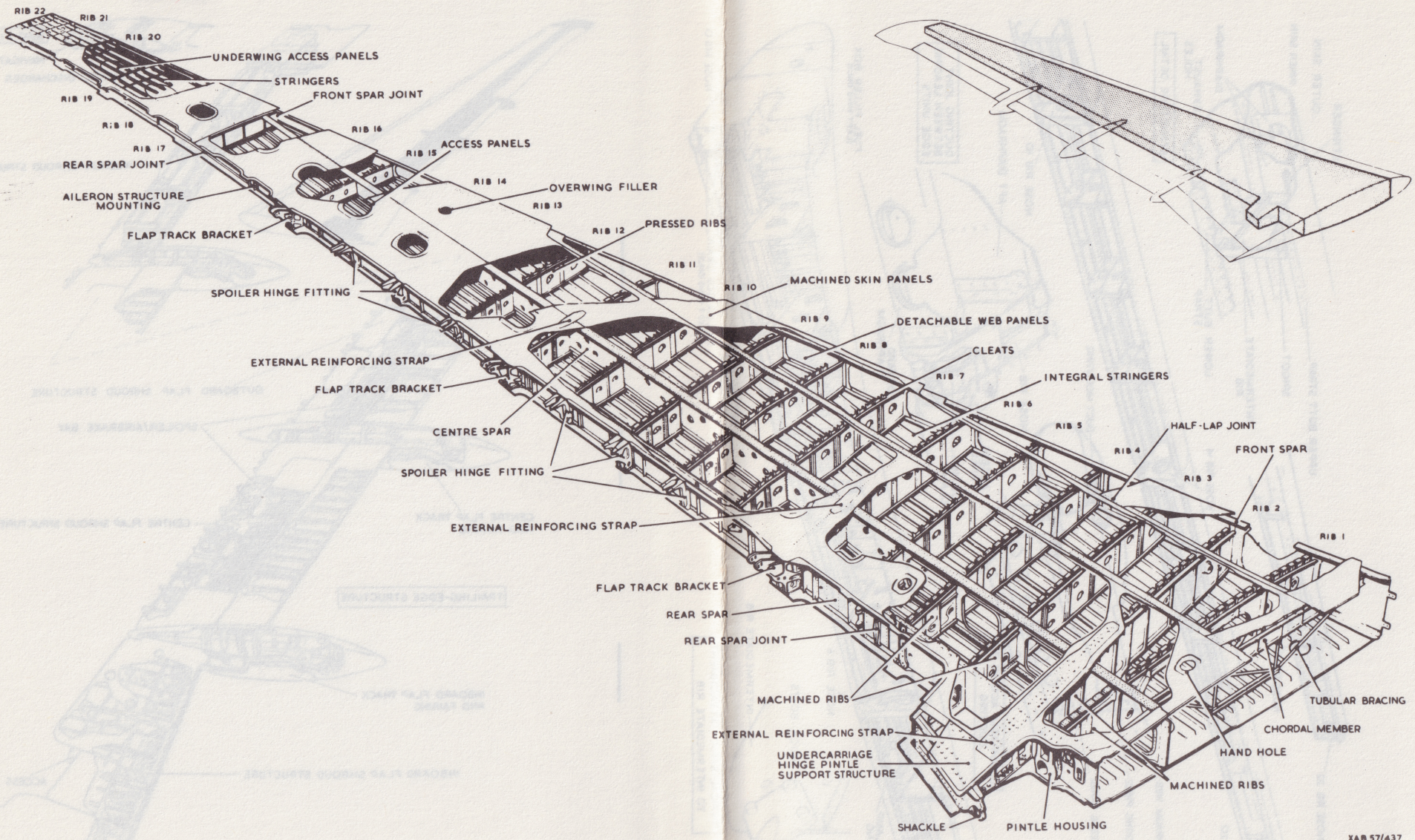
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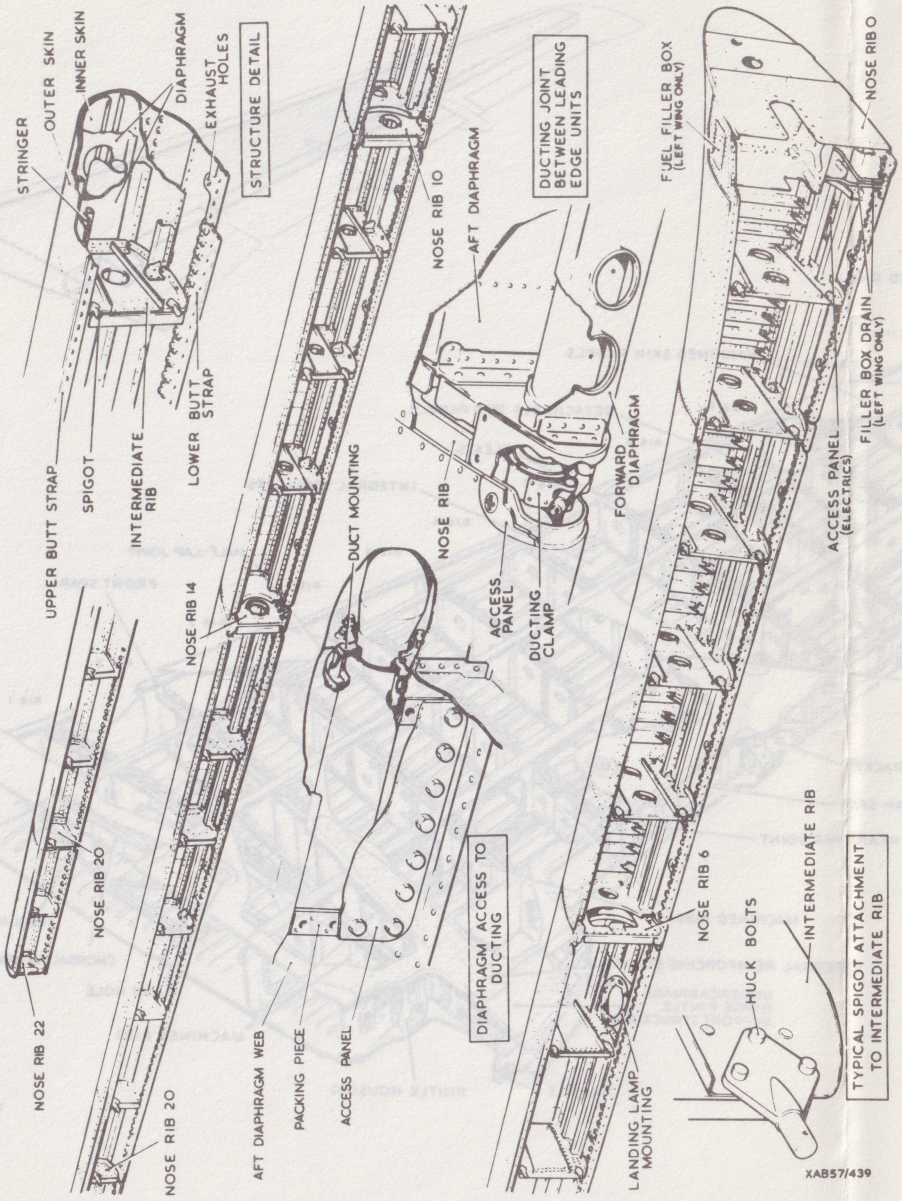
G.A. of Wing
Figure 1

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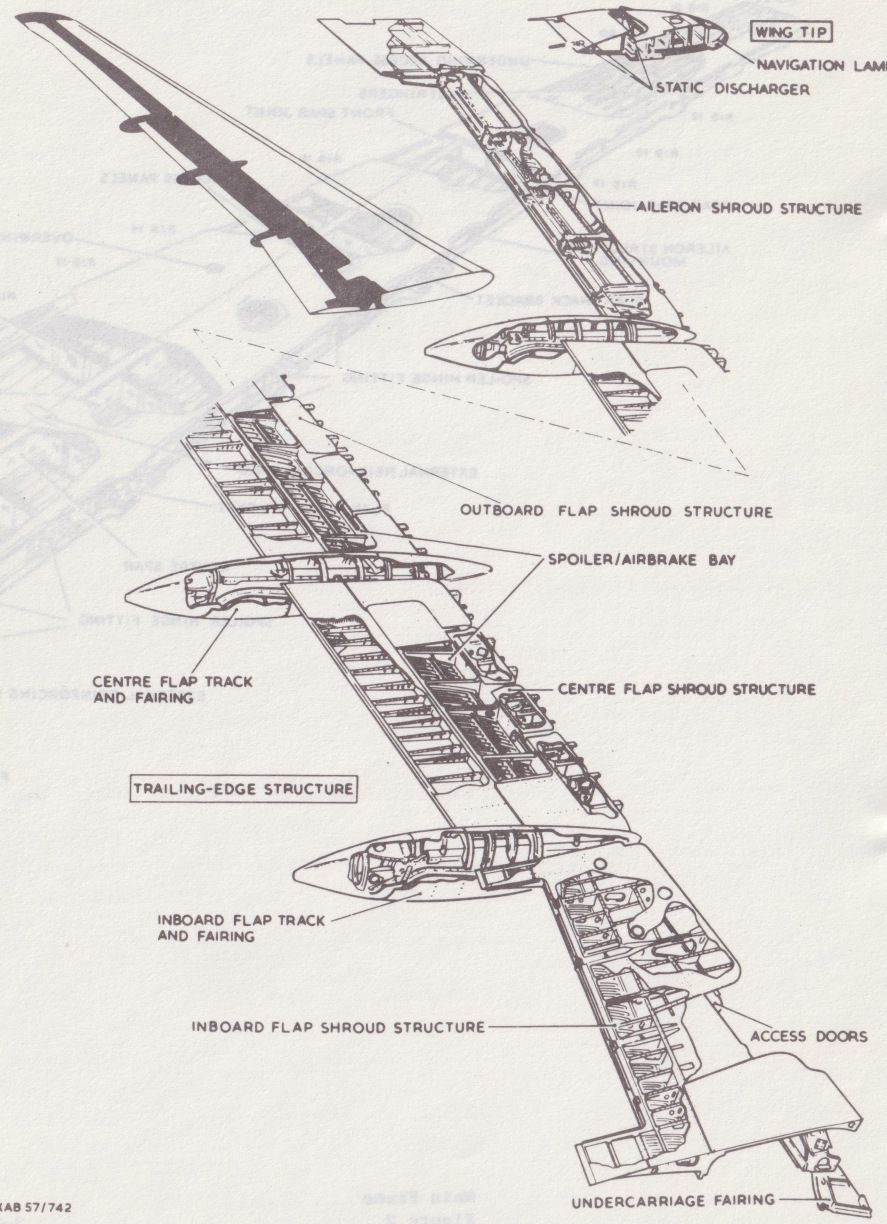


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Main Frame
Figure 2



Leading Edge
Figure 3



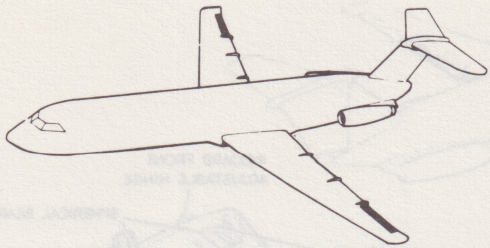
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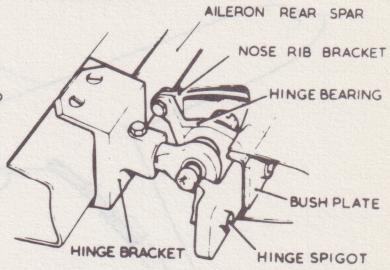
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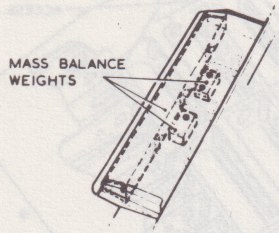
Trailing Edge and Tip
Figure 4

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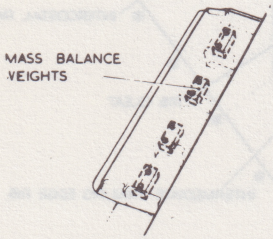




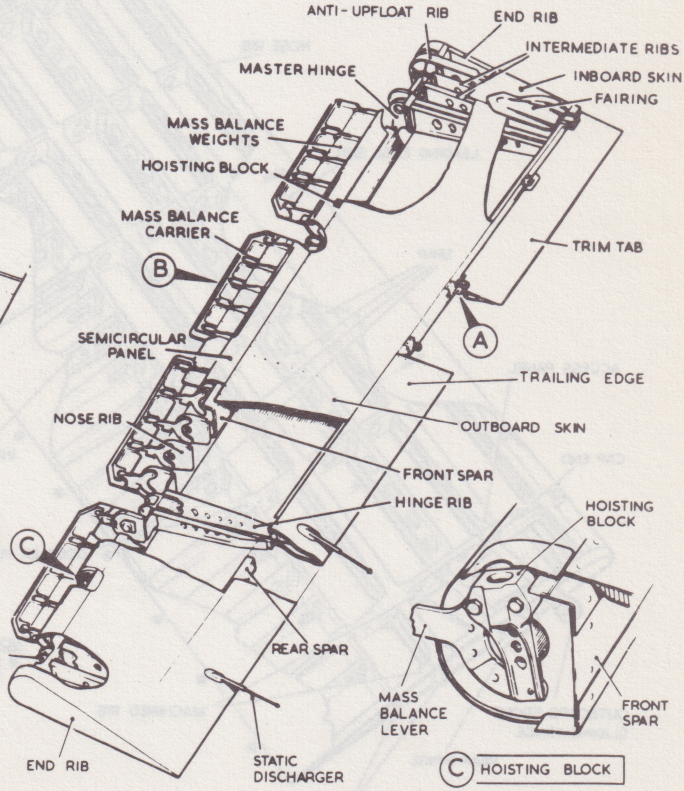
A TRIM TAB HINGE



MOD PM 1331



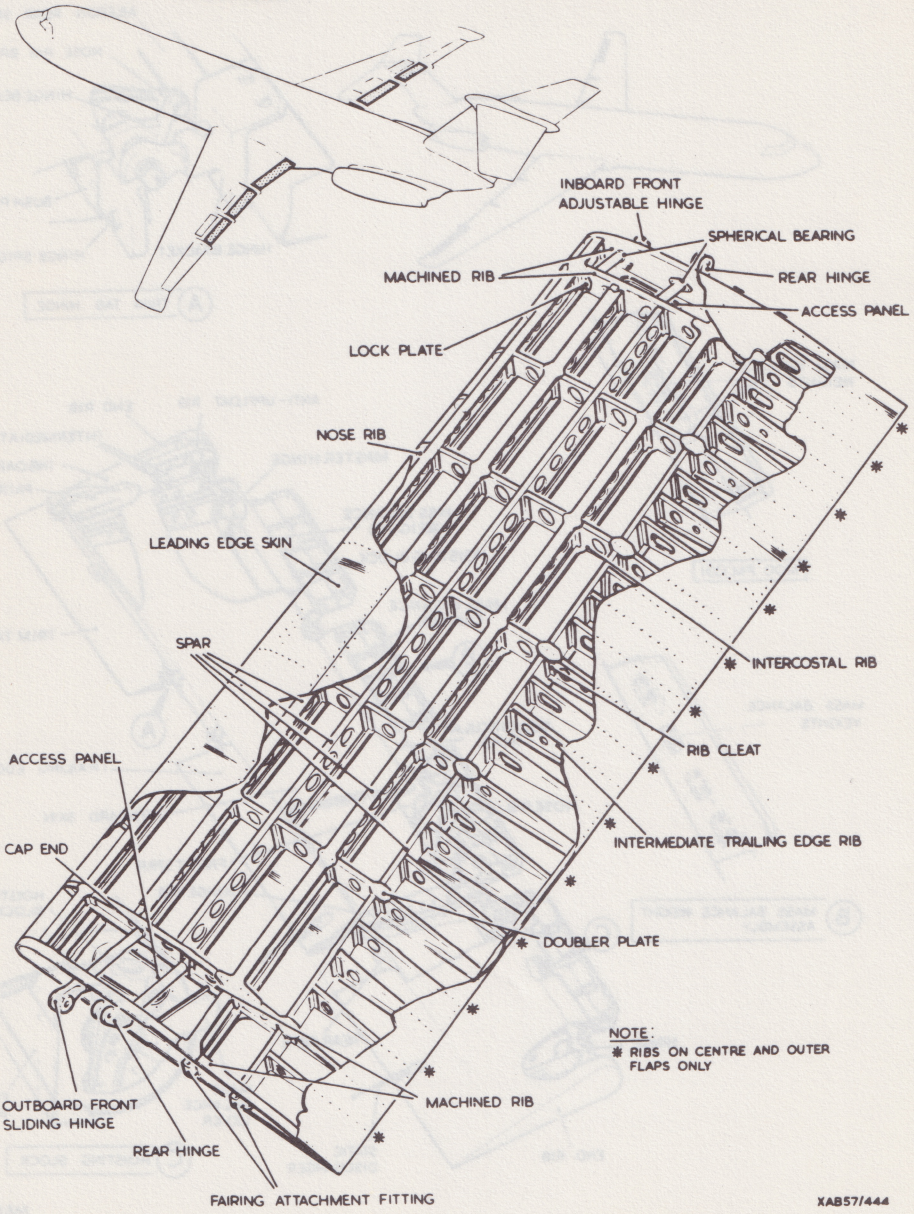
B MASS BALANCE WEIGHT ASSEMBLY



C HOISTING BLOCK

XAB57/741

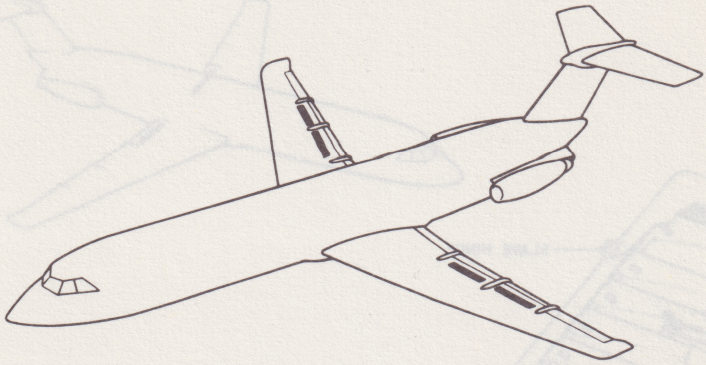
Aileron
Figure 5

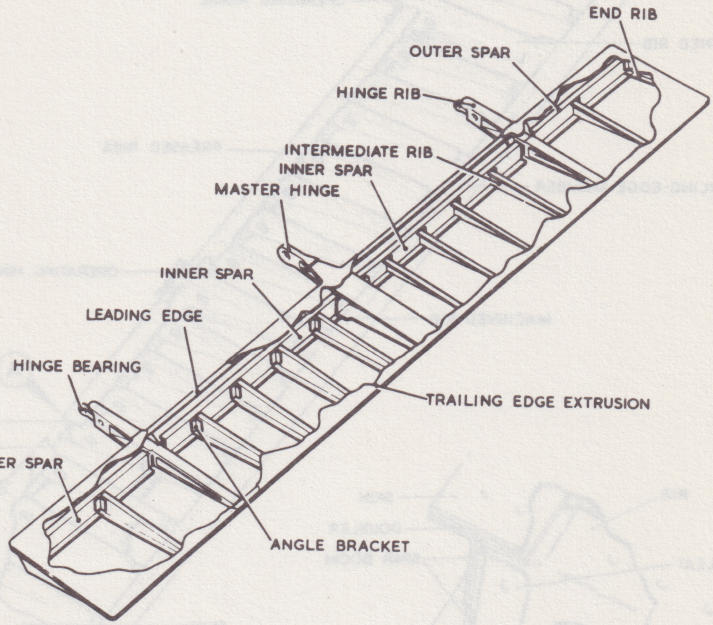


Flap (Typical)
Figure 6

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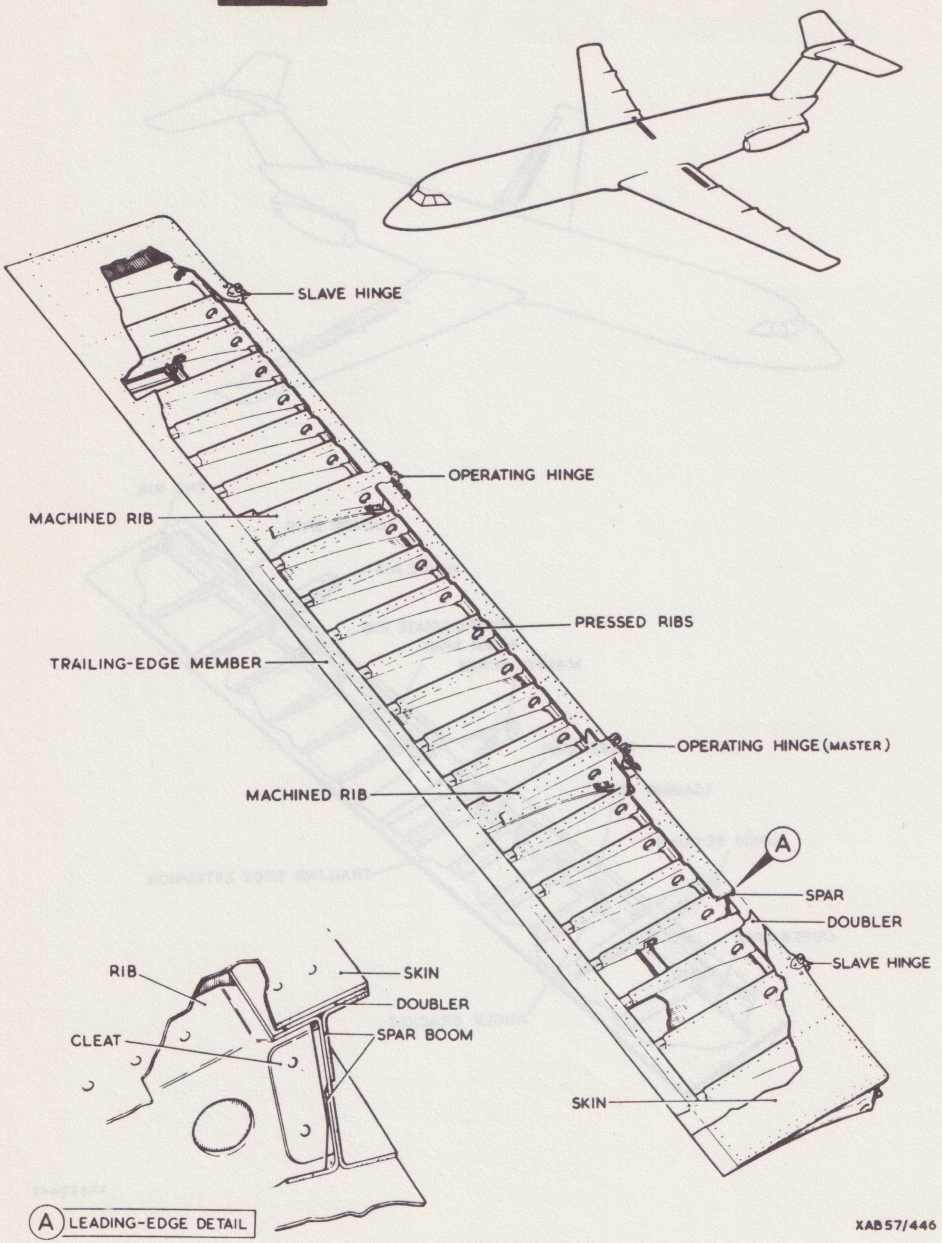




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Spoiler/Airbrake
Figure 7

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Lift Dumper
Figure 8

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